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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER
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MOHAMEDULLA, SALEHA R

ART UNIT	PAPER NUMBER
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1756

DATE MAILED: 11/20/2002

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Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

09/320,946

Applicant(s)

KAMON, KAZUYA

Examiner

Saleha R. Mohamedulla

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 03 September 2002.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-5,7-20,22-26 and 29-49 is/are pending in the application.
- 4a) Of the above claim(s) 25 and 26 is/are withdrawn from consideration.
- 5) ☒ Claim(s) 1,16-20,24 and 44-47 is/are allowed.
- 6) ☒ Claim(s) 2-5,7,8,12,22,39,40 and 48 is/are rejected.
- 7) ☒ Claim(s) 9-11,13-15,23,29-38,41-43 and 49 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

**Priority under 35 U.S.C. §§ 119 and 120**

- 13) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some \* c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

**Attachment(s)**

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) \_\_\_\_\_
- 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_

### **DETAILED ACTION**

Claims 1-5, 7-20, 22-26 and 29-49 are pending. The 35 U.S.C. 112, first paragraph rejections are withdrawn in view of Applicant's remarks.

#### ***Continued Examination Under 37 CFR 1.114***

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on September 3, 2002 has been entered.

#### ***Claim Rejections - 35 USC § 102***

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.

2. Claims 7, 22, 39 and 48 are rejected under 35 U.S.C. 102(b) as being anticipated by US# 5,437,947 to Hur et al.

Hur teaches a phase shifting mask. The phase shift pattern is formed at the edge of a main opening. To form the mask, Hur teaches a transparent quartz substrate is coated with a

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patterned photoresist film. The photoresist pattern is formed through photolithography and therefore Hur teaches a laser or monochromatic beam. The photoresist is a mask to form a trench in the substrate by etching the substrate. The photoresist is removed, and chrome, a light-shading material, is deposited over the substrate, filling the trench in the substrate.

Chemical and mechanical polishing is performed to form a smooth surface for the transparent substrate. Because chemical mechanical polishing is performed, Hur teaches that the surface is planarized. This makes the opaque layer as high as the quartz layer. An oxide phase shifting layer is then deposited and is coated with a photoresist that is patterned. The photoresist is a mask to pattern the underlying oxide layer and the photoresist is removed (Figs. 9A-9F; col. 5, lines 3-25). The trench in the substrate is the hollow section. The opaque material 25 is a shading material and forms a shade pattern as shown in Figure 9. The limitation in claim 7 drawn to the method of forming the phase shift pattern, that is, the recitation of a phase shift pattern formed by selectively etching the substrate, is a process limitation that does not materially limit the structural features of the photomask itself. Claim 7 merely requires a phase shift pattern. The photomask of Hur includes a phase shift pattern.

Hur also teaches in another embodiment forming a patterned photoresist layer over a transparent substrate and etching the substrate to form grooves. The resist is eliminated and a light shading material is deposited over the substrate, filling the trench in the substrate. Chemical and mechanical polishing is performed to form a smooth surface for the transparent substrate. A phase shifting oxide layer is formed over the substrate and a patterned photoresist 27 is formed over the oxide layer 26. The resist layer 27 is used to form phase shifter pattern 28 in fig. 5f. The substrate is then etched to form grooves 29 in Fig. 5h (col. 4, line 30-50; Figs.

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5a-5h, col. 5, lines 12-17). Hur teaches that the thickness  $T$  for shifting the phase of the incident light is given as  $T \geq d$  (col. 4, lines 48-51). Therefore, a phase shift will occur between the deepest etched part of the substrate and the part of substrate with the oxide layer on top. As shown in Figures 5c and 5d, the shade pattern is selectively etched. Therefore, Hur teaches claim 22 limitations.

3. Claims 2 and 7 are rejected under 35 U.S.C. 102(e) as being anticipated by US# 5,824,439 to Lee (herein referred to as Lee '439).

Lee '439 teaches a method of manufacturing a phase shifting mask. A groove is formed in a transparent substrate. A light shading or a light-shielding layer is formed in the groove, creating a shade pattern with a shade section made up of a shade film formed in the hollow groove section. A phase-shifting layer is formed and patterned on the light shading layer (col. 4, lines 3-24).

To form the phase shifting mask, a silicon oxide or nitride layer is formed on the transparent substrate and is patterned with electron beam exposure to expose predetermined positions of the transparent substrate (col. 5, lines 10-15). A polymer layer is then coated over the silicon oxide or nitride patterned layer and the substrate. The layer is etched back with reactive ion etching to form sidewalls 35 (Fig. 4B). The grooved hollowed section in the substrate is formed by using the oxide or nitride layer and the sidewalls as a mask during reactive ion etching (col. 5, lines 15-28). The sidewalls are then removed. A light-shading material is deposited to fill the hollow section. The material and the substrate are polished and planarized through chemical-mechanical polishing. Part of layer is oxidized to form a phase shifting layer.

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The part that is not oxidized is a light-shading layer. The light-shading layer is defined to be within the groove. The oxide or nitride layer is then selectively removed to expose portions of the transparent substrate, thereby forming light transmitting portions (col. 5, lines 29-65).

The limitation in claim 2 drawn to CMP is a process limitation and does not materially limit the structure of the mask. The limitation in claim 7 drawn to etching is a process limitation that does not materially limit the structure of the mask.

### ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. Claims 5, 3, 4 and 8 are rejected under 35 U.S.C. 103(a) as being unpatentable over US# 5,824,439 to Lee (Lee '439) in view of US# 5, 972,540 to Lee (herein referred to as Lee '540).

Lee '439 teaches the limitations discussed above. Lee '439 does not teach that an end section of the phase shift pattern has a sloped shape that decreases.

Lee '540 teaches phase shift patterns that are rounded into sloped phase shift patterns on a transparent substrate (col. 5, lines 20-25, Fig. 10d). Lee teaches that the shape prevents occurrence of pattern error at the 180 degree/0 degree boundary (col. 2, lines 60-68 and col. 4, lines 45-55). Chemical mechanical polishing is used to form planar tops on the rounded sidewalls. The limitations in claims 3 and 4 drawn to the sloped shape being formed by chemical and mechanical polishing is not given patentable weight as claims 3 and 4 are product claims and

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chemical mechanical polishing is a process limitation. The chemical mechanical polishing does not limit the structural features of the mask.

The references are analogous art as they are drawn to manufacturing semiconductor devices using phase shift masks. It would have been obvious to one of ordinary skill in the art to use the sloped phase-shifters of Lee '540 in the mask of Lee '439 in order to prevent pattern errors at a phase boundary (col. 2, lines 65-68).

5. Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over US# 5,437,947 to Hur et al. in view of US# 5,972,540 to Lee (herein referred to as Lee '540).

Hur teaches the limitations discussed above. Hur does not teach that an end section of the phase shift pattern has a sloped shape that decreases.

Lee '540 teaches phase shift patterns that are rounded into sloped phase shift patterns on a transparent substrate (col. 5, lines 20-25, Fig. 10d). Lee teaches that this shape prevents occurrence of pattern error at the 180 degree/0 degree boundary (col. 2, lines 60-68 and col. 4, lines 45-55). The chemical mechanical polishing is used to form the planar tops on the rounded sidewalls.

The references are analogous art as they are drawn to manufacturing semiconductor devices using phase shift masks. It would have been obvious to one of ordinary skill in the art to use the sloped phase-shifters of Lee '540 in the mask of Hur in order to prevent pattern errors at a phase boundary (col. 2, lines 65-68).

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6. Claim 12 is rejected under 35 U.S.C. 103(a) as being unpatentable over US# 5,824,439 to Lee (Lee '439) in view of US# 5, 945,237 to Tanabe.

Lee '439 teaches the limitations discussed above. Lee '439 does not teach that the phase shift pattern is a half tone phase shift pattern with low transmissivity in reverse phase.

Tanabe teaches a half tone phase shift pattern with phase inversion (Figure 1, col. 1, lines 30-40).

The references are analogous art as they are drawn to manufacturing semiconductor devices using phase shift masks. It would have been obvious to one of ordinary skill in the art to use the half tone pattern of Tanabe in the mask of Lee '439 in order to improve phase mask resolution using a simply constructed mask (col. 1, lines 19-28).

7. Claim 40 is rejected under 35 U.S.C. 103(a) as being unpatentable over US# 5,437,947 to Hur et al. in view of US# 5, 945,237 to Tanabe.

Hur teaches the limitations discussed above. Hur does not teach that the phase shift pattern is a half tone phase shift pattern with low transmissivity in reverse phase.

Tanabe teaches a half tone phase shift pattern with phase inversion (Figure 1, col. 1, lines 30-40).

The references are analogous art as they are drawn to manufacturing semiconductor devices using phase shift masks. It would have been obvious to one of ordinary skill in the art to use the half tone pattern of Tanabe in the mask of Hur in order to improve phase mask resolution using a simply constructed mask (col. 1, lines 19-28).



***Allowable Subject Matter***

8. Claims 1, 16-20, 24 and 44-47 are allowed. Claims 9-11, 13-15, 23, 29-38, 41-43 and 49 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. The prior art does not teach or suggest chemical mechanical polishing for the phase shift pattern formed by etching the substrate. The prior art does not teach or suggest selectively etching the shade film using the resist as a mask, selectively etching the phase shift film, and performing a CMP after selectively etching the phase shift film. The prior art does not teach or suggest that a shade pattern is formed in a hollow section of a transparent substrate and a reflection preventing film is formed on a back or surface of the shade pattern. The prior art does not teach or suggest a mask as recited in claims 2 and 7 including a phase shift pattern formed every other opening on the mask, or an auxiliary opening with a shifter which is not resolved adjacent to a main opening, or at the edge of a main opening, or further including a halftone phase shift pattern with a shade pattern, or that the phase shift pattern has a shade pattern formed with a phase shifter, or further including an intermediate type phase shift pattern. The prior art does not teach or suggest forming a first reflection preventing film on the substrate which is selectively etched, forming a shade film on the first reflection preventing film, performing a CMP for the shade film and forming a second reflection preventing film. The prior art does not teach or suggest forming a phase shift film on the shade film, selectively etching the phase shift film and performing a chemical mechanical polish.

***Response to Arguments***

9. Applicant's arguments filed May 3, 2002 and September 3, 2002 have been fully considered but they are not persuasive. Applicant argues that Hur does not teach claim 7 and 22 limitations that the phase shift pattern is in the substrate. However, claim 7 is a product claim and the limitation that the phase shift pattern is formed by selectively etching is a process limitation that does not materially limit the structural features of the mask. In addition, Figure 5h shows the phase shift pattern is formed in the substrate, as discussed above in paragraph 2. The deepest etched part of the substrate forms a phase shift pattern because a phase shift occurs between this part and the part of the substrate with the oxide. Applicant argues that the references do not teach planarizing the phase shift pattern by CMP or that the substrate is further selectively etched to form the phase shift pattern. These arguments are drawn to process limitations that do not further limit the structural features of the mask as claimed.

Applicant argues that Hur and Lee do not teach phase shift patterns in the substrate. However, claims 2 and 7 do not require that the phase shift pattern be in the substrate. Also, the groove or trench in the substrate has edges that are the surfaces of the substrate. The shading film is formed on these surfaces of the substrate. The phase shift pattern is formed directly on the shade pattern in Lee '439. When light is used to expose a substrate with the mask, the shade pattern and the phase shifting pattern are exposed together with the same light and form a specific pattern. Applicant also argues that the shade patterns are not formed on a surface of the substrate because they are formed in a trench of the substrate. However, the trench of the substrate contains a surface of the substrate on which the shade pattern is formed. Therefore, Applicant's arguments are not persuasive.

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***Conclusion***

10. Any inquiry concerning this communication or earlier communications from the Examiner should be directed to Saleha Mohamedulla whose telephone number is (703) 308-1260. The Examiner can normally be reached Monday-Friday, from 8:00 AM to 4:30 PM. If attempts to reach the Examiner by telephone are unsuccessful, the Examiner's supervisor, Mark Huff, can be reached on (703) 308-2464. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9310. The After Final fax phone number is (703) 872-9311. Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0661.

srm SKm  
November 18, 2002



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